UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/489,878	01/21/2000	Manuvir Das	777.361US1	6393

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John E. Whitaker	KANG, INSUN

ART UNIT	PAPER NUMBER
2193	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

	Application No.	Applicant(s)
Office Action Summary	09/489,878	DAS, MANUVIR
	Examiner	**Art Unit**	
	Insun Kang	2193	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>27 April 2005</u>.
2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.
3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
   closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) <u>1-36 and 52-56</u> is/are pending in the application.
   4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5)☐ Claim(s) _____ is/are allowed.
6)☒ Claim(s) <u>1-36 and 52-56</u> is/are rejected.
7)☐ Claim(s) _____ is/are objected to.
8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.
10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.
   Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
   Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a)☐ All   b)☐ Some * c)☐ None of:
   1.☐ Certified copies of the priority documents have been received.
   2.☐ Certified copies of the priority documents have been received in Application No. _____.
   3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
      application from the International Bureau (PCT Rule 17.2(a)).
   * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)
1)☐ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
   Paper No(s)/Mail Date _____.
4)☐ Interview Summary (PTO-413)
   Paper No(s)/Mail Date. _____.
5)☐ Notice of Informal Patent Application (PTO-152)
6)☐ Other: _____.

DETAILED ACTION

1.   This action is in response to the RCE amendment filed 4/27/2005.

2.   As per applicant's request, claims 1, 5-8, 12, 13, 15-18, 20-23, 25-28, 30-32, and

54 have been amended. Claims 1-36 and 52-56 are pending in the application.

Claim Rejections - 35 USC § 112

3.   The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 17-21 are rejected under 35 U.S.C. 112, first paragraph, as failing to

comply with the written description requirement. The claim(s) contains subject matter,

which was not described in the specification in such a way as to reasonably convey to

one skilled in the relevant art that the inventor(s), at the time the application was filed,

had possession of the claimed invention. Claim 17 contains a new matter, "an

assignment of an address of a first variable," which is not supported by the specification.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

4.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5.   Claims 1-16, 22-36 and 52-56 are rejected under 35 U.S.C. 103(a) as being

unpatentable over "Points-to Analysis in Almost Linear Time" by Bjarne Steensgaard

(1/1996) in view of Andersen ("Program Analysis and Specialization for the C

Programming Language," 5/1994).

Per Claim 1:

Steensgaard teaches processing an assignment between two variables in a

program...with a content wherein processing an assignment includes forming a

relationship between two locations that are related to the two variables (page 35, Figure

3, Equation 1). Steensgaard does not explicitly teach that the two locations are

selected to be one level of indirection away from a level associated with the assignment.

However, Andersen teaches that such constraint sub-typing rules at assignments to one

level was well known in the art of software development and performance analysis, at

the time applicant's invention was made, to achieve more precise pointer analysis (page

111, section 4.1.2, 4.4.4, 4.5.1-2) such as those disclosed in Andersen. It would have

been obvious for one having ordinary skill in the art of software development and

performance analysis to modify Steensgaard's disclosed system to use Andersen's

constraint sub-typing rules. The modification would be obvious because one having

ordinary skill in the art would be motivated to provide more precise alias information in a

pointer analysis as suggested by Andersen (page 111, section 4.1.2, 4.4.4, 4.5.1-2).

Steensgaard further discloses that each location includes a label and content, and wherein a content of one of the two locations is selectively unified with a content of the other of the two locations (page 35, Figure 3, Equation 1).

Steengaard does not explicitly teach propagating a label of the first one of the two locations to a label of the second one of the two locations such that the label of the one of the two locations is a subset of the other of the two locations. Andersen, however, does teach that the name of one variable, X_{1a}, contains at least the name of the other variable X_{1b} (page 111, section 4.1.2, 4.4.4, 4.5.1-2). Therefore, it would have been obvious to one having ordinary skill in the art of software development and performance analysis, at the time applicant's invention was made, to process an assignment between two variables in a program where the variables contain labels, as taught by Steensgaard, where the label of one variable is propagated such that one variable label is a subset of another variable label, as taught by Andersen, since if both variables are pointers, the left hand variable now points to the set of variables that the right hand variable points to, which makes the right hand set a subset of the left hand set (page 111, section 4.1.2, 4.4.4, 4.5.1-2).

Per claim 2:

The rejection of claim 1 is incorporated, and further, it would be obvious to delay propagation, since altering the name of a variable while the variable is in use will later the results of the assignment, and produce invalid results.

Per claim 3:

The rejection of claim 1 is incorporated, and further, Andersen teaches forming a points-

to graph by graphically display assignments (page 111, section 4.1.2, 4.4.4, 4.5.1-2).

Per claim 4:

The rejection of claim 3 is incorporated, and further, Andersen teaches

forming nodes and flow lines to indicate relationships between locations (page 111,

section 4.1.2, 4.4.4, 4.5.1-2).

Claim 5 is a computer readable medium version that corresponds to method claim 1,

and is rejected for the same reasons set forth in connection with the rejection of claim 1

above.

Per claim 7:

Steensgaard teaches forming a location for at least one variable in the program,

wherein the location includes a label and a content (figure 1, and page 33, col. 2, lines

35-41). For the limitation, defining a relationship...two locations a subset of the label of

the other of the two locations, this limitation corresponds to method claim 1, and is

rejected for the same reasons set forth in connection with the rejection of claim 1 above.

Per claim 6, this claim is another version of the claimed method discussed in claim 7,

wherein all claim limitations also have been addressed and/or covered in cited areas as

set forth the above.

Per claim 8:

The rejection of claim 6 is incorporated, and further, Steensgaard teaches forming a

location that points to another location, and another defines a pointer-to location of the

location as claimed. X=&Y shows that X contains a reference to a location, and that Y

is that pointed-to location.

Per claim 9:

The rejection of claim 8 is incorporated, and further, Steensgaard teaches defining at

least one level...defines another level of indirection (Figure 4). In this figure, variable

a's relationship with variable x, as well as variables b and c's relationship with y define

one level, where variable b's relationship with variable z defines another level, since

pointed-to location y points to pointed-to location z.

Per claim 10:

The rejection of claim 9 is incorporated, and further, Steensgaard teaches defining the

relationship includes defining a relationship between the two locations that are in the

same level of indirection (Figure 4). Variable y and V variable z are two locations on the

same level that have a relationship.

Per claim 11:

The rejection of claim 9 is incorporated, and further, Steensgaard teaches defining the

relationship between the two locations on different level of indirection (Figure 4).

Variable b and variable z define locations on different levels that share a relationship.

Per claim 13, this claim is another version of the claimed method discussed in claim 8, wherein all claim limitations also have been addressed and/or covered in cited areas as set forth the above.

Per claim 12, this is the base claim of claim 13 wherein all claim limitations also have been addressed and/or covered in cited areas as set forth the above.

Per claim 14:

The rejection of claim 13 is incorporated, and further, Steensgaard teaches assigning a second variable y to first variable x (Figure 3, Equation 1).

Per claim 16, Steensgaard teaches determining that the program is well typed given that the second variable is assigned to the first variable and wherein a content of the pointed-to location is selectively unified with a content of the second location (Figure 3, Equation 1). Steensgaard does not explicitly teach that the determination is made if only if the label of a pointed-to location of the second location is a subset of a label of a pointed-to location of the first location. Andersen, however, does teach that the constraint that the name of one variable, X_{1a}, contains at least the name of the other variable X_{1b} (page 111, section 4.1.2, 4.4.4, 4.5.1-2). Therefore, it would have been obvious to one having ordinary skill in the art at the time of the invention to perform the method of claim 15, further determining that the program is correctly typed given that the second variable is assigned to the first variable and wherein a content of the pointed-to location is selectively unified with a content of the second location, as taught

by Steensgaard, where the determination is made if and only if the label of a pointed-to

location of the second location is a subset of a label of a pointed-to location of the first

location, as taught by Andersen, since if both variables are pointers, the left hand

variable now points to the set of variables that the right hand variable points to, which

makes the right hand set a subset of the left hand set(page 111, section 4.1.2, 4.4.4,

4.5.1-2).

Per claim 15, this claim is another version of the claimed method discussed in claim 16,

wherein all claim limitations also have been addressed and/or covered in cited areas as

set forth the above.

Per claim 22:

Steensgaard teaches forming a location for at least one variable in the program,

wherein the location includes a label and a content (figure 1, and page 33, col. 2, lines

35-41) and forming a relationship between two locations upon an assignment of a first

variable and a dereference of a second variable in the program (Figure 3, Equation 3).

For the limitation, the two locations are selected... selectively unified, this limitation

corresponds to method claim 12, and is rejected for the same reasons set forth in

connection with the rejection of claim 12 above.

Per claims 23-26, they are another method versions of claims 13-16,

respectively, and are rejected for the same reasons set forth in connection with the

rejection of claims 13-16 above.

Per claim 27:

Steensgaard teaches forming a location for at least one variable in the program,

wherein the location includes a label and a content (figure 1, and page 33, col. 2, lines

35-41) and forming a relationship between two locations upon an assignment of a

dereference of a first variable and a second variable in the program (Figure 3, Equation

6). For the limitation, the two locations are selected... selectively unified, this limitation

corresponds to method claim 12, and is rejected for the same reasons set forth in

connection with the rejection of claim 12 above.

Per claims 28-31, they are another method versions of claims 13-16,

respectively, and are rejected for the same reasons set forth in connection with the

rejection of claims 13-16 above.

Per claim 32, it is the computer readable medium version of claim 12,

respectively, and is rejected for the same reasons set forth in connection with the

rejection of claim 12 above.

Per claim 33, Steensgaard teaches forming a relationship between two pointers, as in

pointer b and pointer y in Figure 4 on Page 35.

Per claim 34, Steensgaard teaches an assignment between a first variable and the

address of a second variable in the program (Figure 3, Equation 2).

Per claim 35, Steensgaard teaches an assignment between a first variable and the

dereference of a second variable in the program (Figure 3, Equation 3).

Per claim 36, Steensgaard teaches an assignment between a dereference of a first

variable and a second variable in the program (Figure 3, Equation 6).

Per claim 52:

Steensgaard teaches processing a plurality of assignment statements in a program to

derive a plurality of sets of information, wherein the plurality of sets of information is

distributed among a plurality of levels of indirection (Figure 4).

Steensgaard does not explicitly teach establishing a plurality of flow

relationships... selected to be established one level of indirection away from each of the

assignment statements. However, Andersen teaches that such constraint sub-typing

rules at assignments to one level was well known in the art of software development

and performance analysis, at the time applicant's invention was made, to achieve more

precise pointer analysis (page 111, section 4.1.2, 4.4.4, 4.5.1-2) such as those

disclosed in Andersen. It would have been obvious for one having ordinary skill in the

art of software development and performance analysis to modify Steensgaard's

disclosed system to use Andersen's constraint sub-typing rules. The modification would

be obvious because one having ordinary skill in the art would be motivated to provide

more precise alias information in a pointer analysis as suggested by Andersen (page

111, section 4.1.2, 4.4.4, 4.5.1-2).

Steensgaard further discloses selectively unifying at least one of the sets of

information in at least one level of indirection so as to allow a desired level of analytical

precision within a desired duration of pointer analysis (Figure 5, Equation 1 and page

35, section 5.2).

Per claim 53:

·The rejection of claim 52 is incorporated, and further, Steensgaard teaches in Figure 5,

Equation 1 that if T_1 is not equal to T_2 the cjoin (T_1, T_2), which implies that the sets will

be selectively unified up to the first level of indirection.

Per claim 54:

The rejection of claim 52 is incorporated, and further, Steensgaard teaches that the

desired duration of pointer analysis is about linearly proportional to the size of the

program (page 37, column 1, lines 1-3) as claimed.

Per claim 55, it is the system version of claim 12, respectively, and is rejected for the

same reasons set forth in connection with the rejection of claim 12 above. Further,

compiling, building, and analyzing as claimed are inherent steps in this system in

producing an executable program from source program, and it would be inherent to

transform a source code into an object program by means of a compiler, builder, and

analyzer.

Per claim 56:

The rejection of claim 55 is incorporated, and further, linking is an obvious step in the

compilation process when multiple files in a single program are combined together, and

a linker would be an obvious addition to the system of claim 55.

Response to Arguments

6.   Applicant's arguments filed 4/21/2005 have been fully considered but they are

not persuasive.

       Per claim 1:

       The Applicant states that Andersen fails to teach or suggest "...forming a

relationship between two locations that are related to the two variables, wherein the two

locations are selected to be one level of indirection away from a level associated with

the assignment..."

       In response, the examiner did not state that Andersen teaches all the limitations

in the claim. The claim 1 is rejected by Steensgaard in view of Andersen. Further,

Anderson teaches such constraint sub-typing rules at assignments to one level to

provide more precise alias information in a pointer analysis and to selectively unify a

content of one of two locations with a content of the other of the two locations (i.e. page

35, Equation 1). The applicant states that Andersen's algorithm would "require a

prohibitively long amount of processing time." However, this statement does not appear

to show that the reasons to combine with Steensgaard are improper as the long

processing time would not make the combined teachings inoperable. If applicant

means anything more, this must be brought out in the claims to further clarify the

invention. Therefore, in view of the combined teachings of Steensgaard and Andersen, the rejection of claim 1 is considered proper and maintained.

    Per claims 52 and 55:

The applicant states that Steensgaard in view of Andersen does not disclose the limitations of claims 52 and 55 for the reasons set forth in connection with claim 1. As shown above, the rejection of claim 1 by Steensgaard and Andersen is proper, and accordingly, the rejections of claims 52 and 55 are also maintained.

    Per claims 2-4, 53, 54, and 56:

The applicant states that claims 2-4, 53, 54, and 56 are allowable as being dependent on the allowable base claims. As has been shown above, the rejections of the independent claims 1, 52, and 55 by Steensgaard and Andersen is proper, the argument that claims 2-4 and 53, 54, and 56 are allowable as being dependent on the allowable base claims is considered moot. Accordingly, the rejections of claims 2-4, 53, 54, and 56 are proper.

    Per claims 5-36:

The applicant states that Steensgaard in view of Andersen does not disclose the limitations of claims 5-36 for the reasons set forth in connection with claim 1. As shown above, the rejection of claim 1 by Steensgaard and Andersen is proper, and accordingly, the rejections of claims 5-36 are also maintained.

7.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to Insun Kang whose telephone number is 571-272-3724. The examiner can normally be reached on M-F 7:30-4 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kakali Chaki can be reached on 571-272-3719. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Any inquiry of a general nature or relating to the status of this application should be directed to the TC 2100 Group receptionist: 571-272-2100.

I. Kang
Examiner
5/27/2005

ANIL KHATRI
PRIMARY EXAMINER